

High Temperature Radiators for Electric Propulsion Systems, Phase I

Completed Technology Project (2011 - 2011)



Project Introduction

The VASIMR propulsion system uses a high temperature Loop Heat Pipe (LHP) radiator to reject heat from the helicon section. The current baseline radiator uses titanium/water LHPs, however, deployable radiator and trace heating features are required to keep the water in the condenser from freezing when the radiator is turned off. The proposed project will develop high temperature toluene LHP radiators that will minimize the freezing problem, since the freezing temperature of toluene is roughly 100

o

C lower than water. Preliminary calculations on the toluene LHP radiator showed that a graded wick is required, with the pore size decreasing from the center to the surface of the wick. One goal of the project is to develop a graded alumina wick that reduces wick mass, back conduction, and pressure drop, enabling toluene as the working fluid. The ceramic wicks will also have near net shape fabrication, eliminating much of the current machining which adds costs to the LHP wicks. Optimizing the radial variation in porosity and permeability reduces the transport line sizes of toluene LHPs, significantly improving their mass and performance. The ceramic wicks can also be used in conventional LHPs, potentially reducing the LHP wick mass, pressure drop, and back conduction by 50 to 90% when compared with conventional nickel wicks. Phase I will demonstrate the feasibility of fabricating these wicks, demonstrate the wicks' machine-ability, conduct life tests, and evaluate the benefits of a graded wick versus a conventional wick with uniform properties. In Phase II, ACT will fabricate and test toluene LHP radiators with graded ceramic wicks to fully demonstrate their performances. We expect the technology to reach TRL 6 at the end of Phase II.



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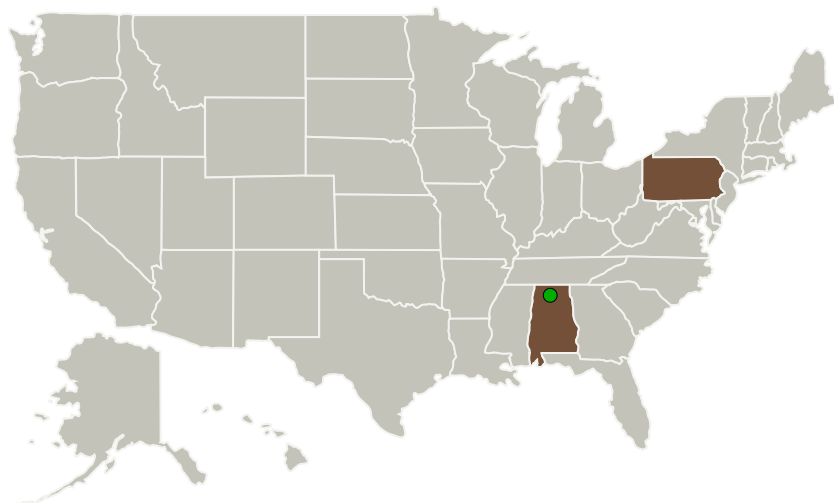
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Advanced Cooling Technologies, Inc.	Lead Organization	Industry	Lancaster, Pennsylvania
● Marshall Space Flight Center (MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Pennsylvania

Project Transitions

▶ **February 2011:** Project Start

✓ **August 2011:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/138224>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Advanced Cooling Technologies, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

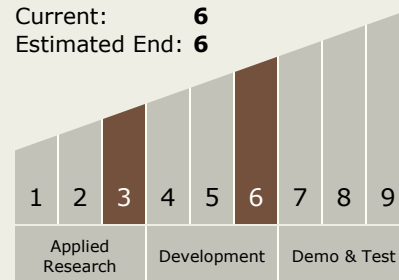
Carlos Torrez

Principal Investigator:

William Anderson

Technology Maturity (TRL)

Start: **3**
Current: **6**
Estimated End: **6**



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Technology Areas

Primary:

- TX01 Propulsion Systems
 - └ TX01.2 Electric Space Propulsion
 - └ TX01.2.2 Electrostatic

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System